Article: Library Systems: the trends, the developments, the future

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Introduction

The rate of technological change and innovation in libraries has accelerated since the advent of the Web. Libraries continue to honour the essence of Ranganathan's Five Laws, by administering 'traditional' library services in increasingly technologically novel ways and managing an ever expanding number of distributed heterogeneous digital resources or services with a variety of disparate technologies. Although libraries, particularly in the HE sector, now deploy a multiplicity of technologies, the Integrated Library System (ILS) remains the technological foundation of the library. The public face of the ILS, the library online public access catalogue (OPAC), is offered as the locus of resource discovery; guiding users to information materials, both hard copy and digital, and providing a unified point of entry for the numerous electronic services a library has to offer. Similarly, the private face of the ILS remains the assured foundation of library operations; indispensable to the internal workflow, for example cataloguing, circulation control, acquisitions, and so forth, and a necessary tool in the management of modern research libraries.

Initially, the deployment of technology within libraries was quite selective. It was predicated on the ability to improve internal workflows and make greater efficiencies within long established library operational models. Today, technology often drives the library, creating the possibility of new services for users or entirely new delivery mechanisms. Without question, the piecemeal and routine enhancement of "back of house" ILS design and computational advancements, as well as improvements in the network and processor capacity, will continue to bring greater operational efficiencies, but it is the public face of the ILS where the biggest impact of technology can be observed. That is not to state that the LIS community is not exerting some influence on how our libraries and information services develop, as we shall see; however Web trends and software innovations - by virtue of providing the basis for most ILS technology - have become, in turn, the key drivers of library system innovation.

The purpose of this article is therefore to introduce some of the latest developments and trends taking place with respect to library systems, and to make some informed judgements on what the future holds. Any detailed discussion is outside the remit of such a brief exposition; some references and further reading are provided for this purpose. Rather, we wish to draw attention to more general developments, particularly with reference to the public face of the ILS since, as already noted, it is in this area that development and innovation is best exemplified. Unsurprisingly, such trends and developments are numerous, and many are in fact interrelated. In order to provide some focus, we have grouped ILS trends and developments according to their characteristics, under four broad headings: *the portal, greater interconnectivity, towards Web 2.0* and *metadata*.

The Portal: gateway to anywhere

Portals are not, in themselves, a particularly new phenomenon. Portals emerged in the late 1990s as a means of counteracting the downside of the Web: information overload. Until recently definitions of what constitutes a portal have been varied . Powell (2003) offers a useful, succinct and much cited definition:

"A portal is a network service that brings together content from diverse distributed resources using technologies such as cross searching, harvesting, and alerting, and collate this into an amalga-

mated form for presentation to the user".

Over recent years, ILS vendors have been taking tentative steps towards offering the kind of portal technology characterised above, either as stand alone products or as modules for existing systems, or even as part of the base system. Although many libraries have resisted the temptation, a significant trend has emerged with the OPAC user interface providing "one stop shop" access to library collections and services via a single Web portal interface, and amalgamating the result sets.

Such technology in libraries has proliferated as increased customisability is offered to users. Users are often already au fait with personalised portal tools. The growing interactive experiences enjoyed by users in commercial services such as eBay and Amazon, portals such as MyYahoo!, or even the rival "library" services of commercial information portals like WebFeat, Questia or Ebrary and subscription services provided via Athens such as ScienceDirect, SpringerLink and ProQuest, have whetted expectations, rendering the future and universal "portalization" of OPACs almost inevitable. Indeed, it is not uncommon for Virtual Learning Environments (VLEs) to provide students with a degree of control over their personal information space. This trend, now being mirrored by OPAC technology, has become manifest in the latest packages offered by vendors, many of which also come with the tools necessary for librarians to customise and build their own bespoke portals. As a common point of resource discovery, online public access portals (OPAPs) not only encompass access to heterogeneous information resources (federated searching) and the amalgamation of result sets, but commonly offer simultaneous access to e-mail, synchronous chat facilities, alerting services, user profiling, authentication management tools, online payment tools, and so on. As can be discerned from the latest versions of 'Horizon Information Portal' offered by SirsiDynix (2005), or 'MetaLib' by ExLibris (2005), each advancement in OPAP technology offers libraries ever greater flexibility, ever greater amounts of customisation or personalisation potential, and more interaction with commercial information services.

Greater Interconnectivity

As noted, the ability to integrate local and remote content and permit federated searching of it by users is now intrinsic to the library portal concept. Few vendors would meet the demands of the corporate sector if they did not offer this sort of functionality. Yet, for many institutions, there remains a large body of information residing beneath the 'library radar' and still to be integrated, either as a result of technical or interoperability constraints, or due to a lack of holistic thinking by host institutions. Indeed, for many universities and further education institutions the possibility of unified access to information resources within VLEs, institutional repositories, learning object repositories, content management systems (CMS), and digital libraries remains problematic. An emerging trend is therefore one of greater interconnectivity.

With the Joint Information Systems Committee (JISC) (2004) promoting better integration between digital libraries, VLEs and e-science activities, and the Centre for Educational Interoperability Standards (CETIS) heightening awareness of interoperability issues within the e-learning community, such improved interconnectivity will emerge and doubtlessly enrich the public face of the ILS further. More importantly, vendors are likely to to improve their support for new hardware/software platforms and metadata schema, in an effort to be the first to brandish new cross-walks for truly heterogeneous federated searching.

Of course, emerging technologies and developments will also play a crucial role in enhancing interconnectivity. The Web trend towards the OpenURL standard is already firmly entrenched within the systems vendor community. Many vendors now accommodate the interrogation of databases via OpenURL, with library portal products allowing search profiles to be constructed for those remote services that are already OpenURL compliant. Greater support for next generation searching technologies, particularly Search/ Retrieve Web Service (SRW) (ZING, 2005), has also been announced by some of the main vendors. Appropriate toolkits, such as that from IndexData, are already available as open source software for the more adventurous local developer. . SRW supports numerous syntaxes and is an attempt by the ZING (Z39.50 International: Next Generation) team to foster uptake of the powerful capabilities of Z39.50 by implementing them in tandem with updated Web-friendly protocols and technologies to provide a low barrier to entry for services outside the traditional Z39.50 fraternity.

Towards Web 2.0

The concept of 'Web 2.0' is rather abstract, but it embodies a widely held recognition that the World Wide Web will soon graduate from a predominantly static collection of pages to a computing platform in which applications and services dominate. Many of these technologies are already with us and are evolving rapidly; they include XML, SOAP, REST, WSDL, etc. Much portal technology, for instance, now utilises portions of the Web 2.0 ethos and initiatives such as ZING are an attempt at harnessing the promise of Web 2.0 for the library community. From this perspective library systems, and in particular OPACs, are already moving in the right direction, but true Web 2.0 has yet to be fully realised and the community would perhaps benefit from a little more haste.

Nevertheless, tentative steps towards the increased use of Web services to enrich the OPAC experience for the user can be observed. Networked-enabled communication and open standards, providing a low barrier to entry, give libraries and library system vendors the raw tools with which to enhance library services and add greater functionality. Such a trend resonates squarely with the increasing Open Source movement which will, as Dorman (2005) predicts, create a "revolution" in library systems and software. Amazon Web Services (AWS), for example, can now easily be invoked by a library OPAC during a query to provide added value to a user's result set. Book jacket images, reviews, contents pages, etc. can all be integrated within an OPAC results page to enrich individual bibliographic records. This is not new; for example, Syndetic Solutions have been providing similar added value for top end library systems since the late 1990s. AWS, however, is ubiquitous, is not proprietary, offers greater flexibility and customisation potential, and is ultimately free to be used by anyone anywhere anytime for any purpose. Wade Roush's article, "Amazon: Giving Away the Store", provides an insight to the possibilities awaiting not just library users but users of the Web the world over (Roush, 2005).

The use of domain specific Web services in tandem with the OPAC is inevitable and significant developments have already emerged in this area. OCLC's xISBN service (OCLC, 2005a), for instance, is a free Web service supplying International Standard Book Numbers (ISBNs) associated with individual intellectual works represented in the WorldCat database. On submission of a particular ISBN, xISBN can return a list of associated ISBNs by running OCLC's "FRBR Work-Set Algorithm" (FRBR is discussed below). OCLC also provides a modified version of Jon Udell's Java-enabled "Library Lookup bookmarklet" (2005)

to use xISBN as a "bookmarklet". Closer to home, the Centre for Digital Library Research (CDLR) is undertaking another phase of the JISC-funded High Level Thesaurus Project (HILT) by re-rendering the HILT Pilot Terminologies as a Web service using SOAP with SRW (HILT, 2005). Whilst only a pilot, such a service, if properly integrated with library services and systems, can transform subject searching for library OPAC users everywhere. Web services, in their various permutations, therefore have a significant contribution to make in enhancing OPAC functionality at comparatively little cost to the host institution or vendor. In point of fact, it is not unreasonable to predict that future library systems - integrated with institutional digital object repositories - will eventually function as Web services themselves; allowing users around the world to harness library assets in order to build new and innovative information services in much the same way that we are currently using AWS or Google.

Vendors have been slow to harness the potential of Web services fully, although some are further ahead than others. For example, Talis, is currently developing Silkworm (Talis, 2005) which purports to implement a "paradigm shift" to greater openness and collaboration within the library community. The project proposes a robust and reliable "deep linking directory service" to allow libraries to make their resources available to a wider audience than ever before. Such a directory would function as a platform upon which to develop new services or enhance existing ones by invoking Web services such as xISBN, AWS, and Google Maps.

Metadata

The realm of metadata is one that will radically change in the near future. By necessity, this change will be reflected in ILS, and although it is likely to be complicated for libraries to implement, this change is set to revolutionise the bibliographic universe and improve libraries' ability to meet the needs of the 21st century user. The biggest agent of change will be the application of "Functional Requirements for Bibliographic Records" (FRBR), developed by the International Federation of Library Associations and Institutions (IFLA).

FRBR is an approach to bibliographic metadata using a generalised entity-relationship. The model offers a hierarchical perspective on the composition and relationships of bibliographic and authority records, as well as greater precision in the vocabulary used to describe information entities, in contrast to the single flat record concept underpinning traditional cataloguing. Specifically, the model identifies four hierarchical levels of bibliographic representation: "work", "expression", "manifestation", and "item". A catalogue based on FRBR principles has the potential to provide the user with a much more useful view of information than current systems can possibly deliver. An exhaustive explanation of FRBR is beyond the scope of this article. FRBR is complex, and can be quite intimidating; for an introduction see Tillett (2004, 2005), Bowen (2005), Le Boeuf (2005), and Yee (2005).

Despite the complexity, FRBR should, rather paradoxically, make the ever-expanding bibliographic universe far simpler for the user to navigate. A FRBR-enabled catalogue can offer a more flexible approach to information retrieval, enabling records and the resources they represent to be viewed in a more logical fashion. Such an approach will facilitate the collocation of resources and user-navigable hierarchies, with the relationships between resources emphasised and contextualised. For example individual items,

whether they are in the form of an e-book, printed monograph or DVD, can be collocated under a single point-of-entry in the form of the "work" title. In the OPAC users will be able to start with a standard title such as "Hamlet" and easily identify the many forms in which the play is expressed, including the movies, audio recordings, printed scripts, dance interpretations, etc. The FRBR model offers better control over the explosion of multiple digital manifestations of resources in today's global information environment, and is compatible with the ultimate Web 2.0 aspiration of the Semantic Web. A downloadable version of the FRBR Work-Set Algorithm has been made freely available by OCLC allowing the automatic conversion of MARC21 metadata to the FRBR model (OCLC, 2005b).

Library systems vendors have a large part to play in bringing FRBR to fruition. Some vendors already have fully functioning FRBR-based systems , while most are preparing to offer full or partial "FRBRization" in the near future. As Bowen (2005) notes, some vendors have hitherto been resisting further investment in FRBR claiming it is unclear whether "users really want or need the improvements that FRBR may offer". Yet with large scale backing from OCLC, IFLA and other international bodies, and the encouragement of the LIS practitioner community, the trend towards FRBR now appears inevitable.

As FRBR is fully embraced by the community, the ILS can obviously expect better tools to streamline FRBRization and to manage FRBRized records, as well as general tools to manage other XML-based metadata schema such as MODS, METS, RDF, and others. These are important for integration with other systems hosting heterogeneous simple or complex digital objects. However, despite these seismic developments, it is the library OPAC which will experience the biggest change, as this abstract bibliographic model is replicated via the user interface. Such an interface is indeed beguiling and can be visualised in the literature (Ibid.); online examples are also available (OCLC, 2005c). Given FRBR's potential impact on users, it constitutes the most significant development influencing the future trends of library systems.

So, where are we heading?

These are not the only developments currently influencing the future of libraries and library systems, but we think they give some indication of what to expect in general terms.

We have only mentioned Google in passing, and have not discussed the impact of automatic mass text-indexing and similar approaches. They will continue to be an important component of the user's information retrieval toolkit, but are weak in exposing intellectual relationships between resources, do not reach many parts of the digital environment, and cannot cover non-digital resources at all. It is in these areas that the library-based approach will remain significant. The technologies we have identified allow users to obtain the best out of all of the approaches in a complementary, rather than competitive, way.

The simplification of metadata structure and content is a necessary accompaniment to the developments we have outlined; each of the four bibliographic layers in FRBR is simpler than the traditional single-layer approach. But the simplification has to be accompanied by a more sophisticated approach to bibliographic relationships to allow the user to build coherent assemblages out of many more chunks of metadata. This is best achieved through standardisation of the content of the metadata, and we expect to see a reversal

of the current desire to dumb-down "catalogue" records in the mistaken belief that this is the same as simplification. In other words, structured metadata content is likely to make a come-back. And it will be supported by the increased availability of global authority files for names, places, and subjects coupled with emerging generalised rules for determining content such as Resource Description and Access (RDA) which is being developed by the Joint Steering Committee for Revision of Anglo-American Cataloguing Rules (2005).

The ability of OPACs to offer access to a wide range of library and information services supplied by multiple organisations, or "shared services", will reduce the need for the single local gateway currently exemplified by the OPAC. There will be many ways into the information environment, ranging from personalised domestic portals to predetermined sets of services offered by specific organisations for specific purposes; libraries will be a subset of the latter. And users will want access to any or all of these via wireless and wired connections using a variety of interface devices, from mobile phones to plasma screens.

Print-based information will remain significant for the foreseeable future, and physical locality will be an important "landscaping" parameter for determining user search strategies. But instead of being restricted to resources in the local library, users will expect to utilise all libraries meeting their requirements, such as those within a specified travelling time or those providing full wheelchair access. We can therefore expect increased regionalisation of information services, with consortia based on geographical location striving for "best value" through improved sharing of resources and collaborative acquisition policies. "Metasearching" across multiple, disparate catalogues, indexes and other finding-aids is becoming the norm, using the complementary architectures of distributed "union" catalogues employing Z39.50/SRW and related technologies, known as "clumps", and physical catalogue aggregations using metadata harvesting.

And we can expect multiple layers of service sharing, from local to regional to national to international, with different aggregations in each layer serving different user groups. It is highly unlikely that a single central catalogue of all the world's resources will ever be feasible, so at some level this must involve a distributed approach using some of the "hyper-clumping" ideas explored in the CC-interop project (CC-interop, 2005).

To sum up, it will be all for one, and one for all. Think globally before acting locally!

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